Wind Energy on the Big Island

Presented by:
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Honolulu Hawaii
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History

Existing Wind Farms
Kamaoa: 7.0 MW
Lalamilo: 2.3 MW

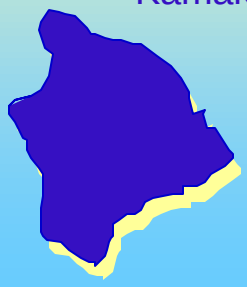
History

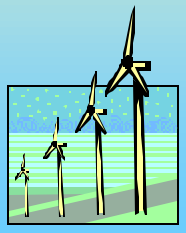
No longer in Operation:

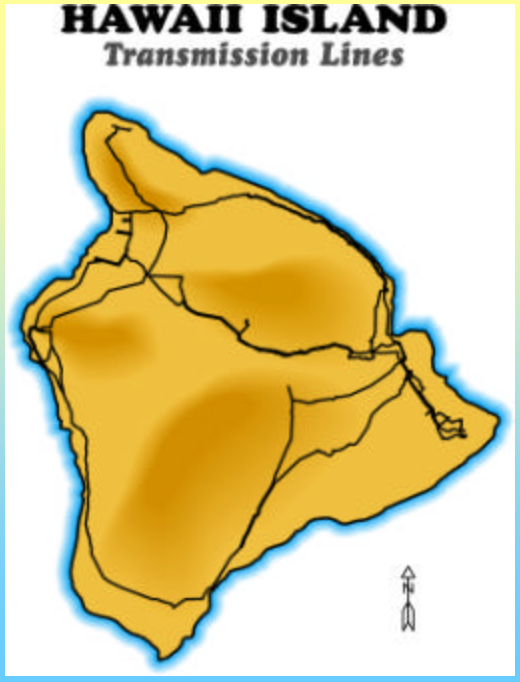
Wind Power Pacific Investors 1: 306 kW

Wind Power Pacific Investors 2: 3060 kW

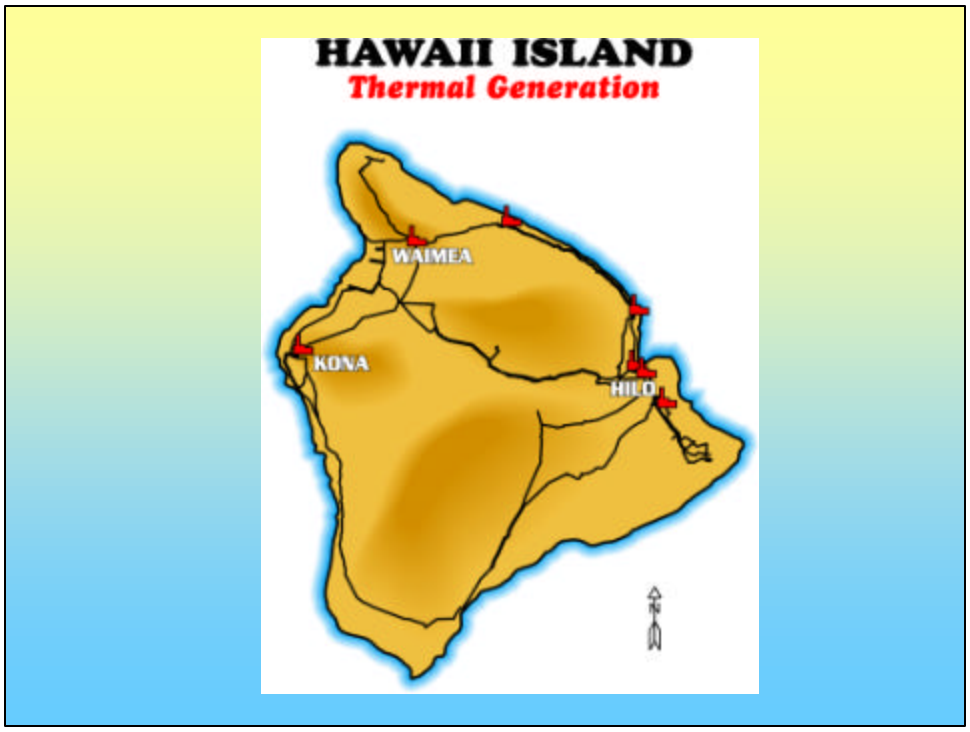
Kamakani Ikaika: 500 kW





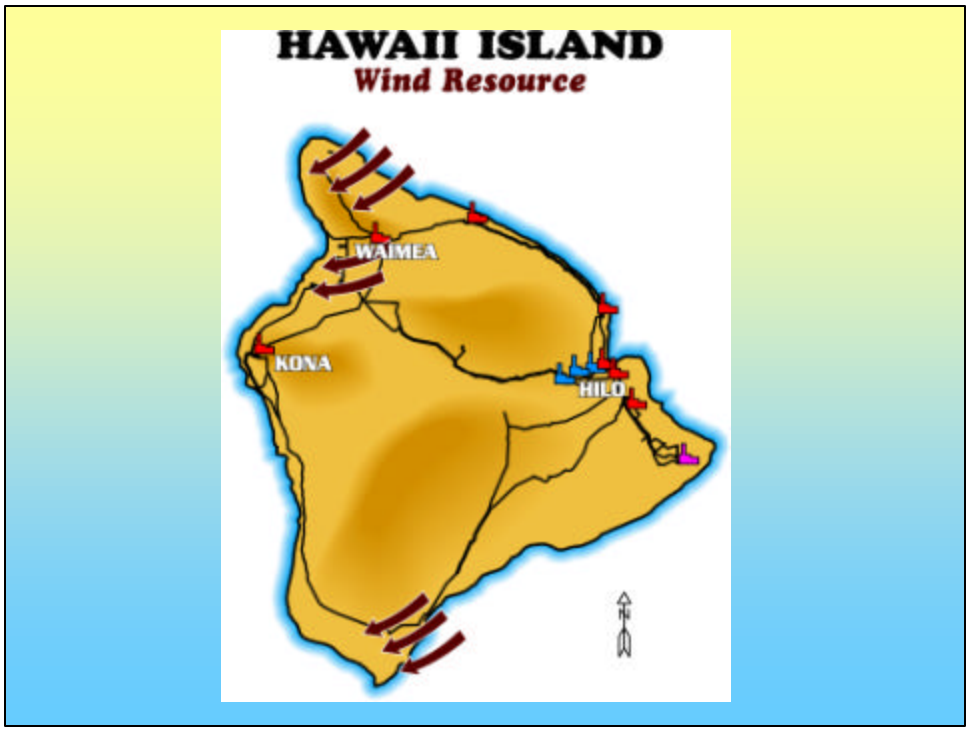



HAWAII ISLAND
Major Load Centers
WAIMEA
KONA
HILO


HAWAII ISLAND
Thermal Generation
WAIMEA
KONA
HILO

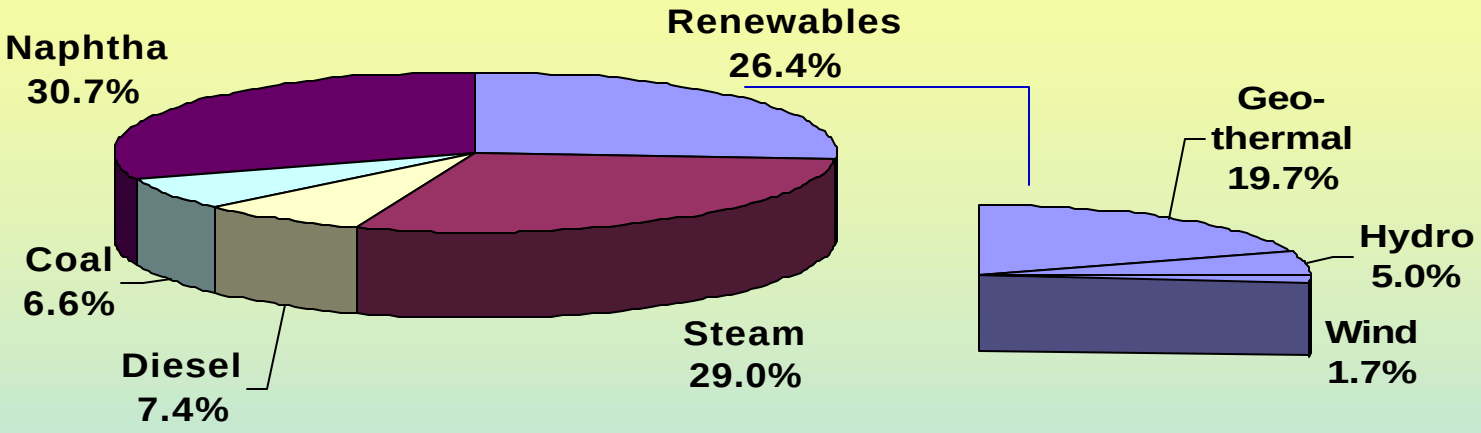

HAWAII ISLAND
Geothermal
WAIMEA
KONA
HILO


HAWAII ISLAND
Hydroelectric
WAIMEA
KONA
HILO


HAWAII ISLAND
Wind Resource
WAIMEA
KONA
HILO

Renewables on the HELCO System in 2001

Renewable energy resources including hydroelectric, wind, and geothermal, supplied approximately 26% of the Big Island's electricity needs in 2001.



GEOTHERMAL provided 19.7% of the island's electricity in 2001. The Puna Geothermal Venture power plant is located in the lower Puna district near Pohoiki.

HYDRO supplied 5.0% of the island's electricity in 2001. Power plants include HELCO's Puueo and Waiau hydroelectric plants and the Wailuku River Company's hydroelectric facility all located on the Wailuku River near Hilo.

WIND supplied 1.7% of the island's electricity needs in 2001. HELCO's Lalamilo wind farm located near Waimea is capable of producing up to 2.0 megawatts of wind power. HELCO also purchases power from Apollo Energy Corporation's wind farm located at South Point. Future wind projects from independent power producers are planned at Kahua Ranch and Upolu Point in North Kohala.

SOLAR benefits thousands of Big Island customers by providing power through small-scale photovoltaic (PV) systems and by reducing electrial loads through solar water heating. Large PV installations by non-utility generators provide over 200 kilowatts of load reducing power. HELCO continues to promote solar technologies through education and demonstration projects including the Sun Power for Schools program.

System Load Demand

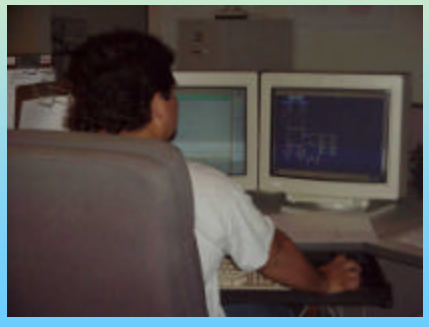
Throughout the day, the system load demand varies on the HELCO power grid

The minimum load is in early morning

The peak load is at dusk

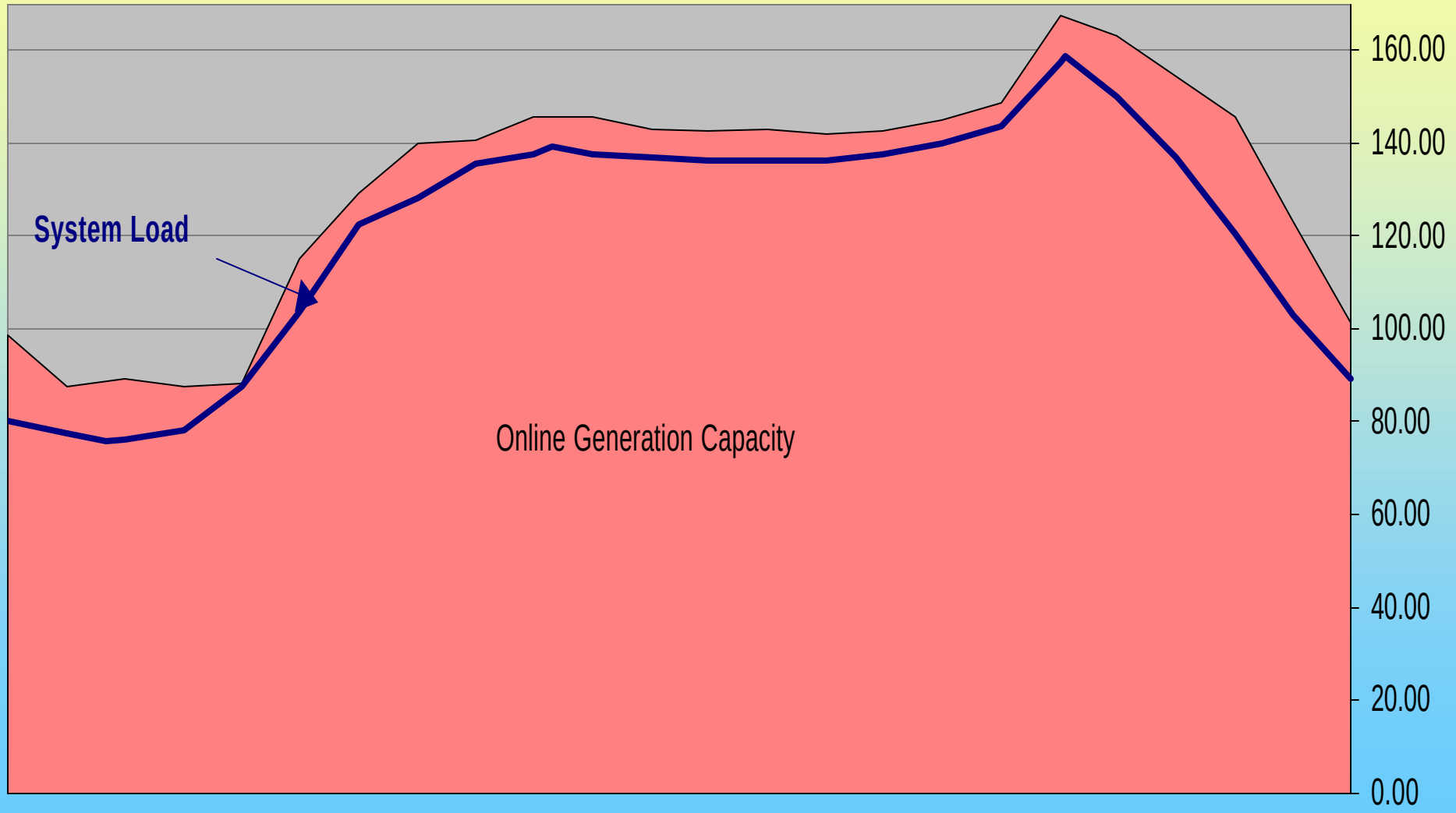
System Operations

HELCO System Operations matches the generation production to the system demand throughout the day

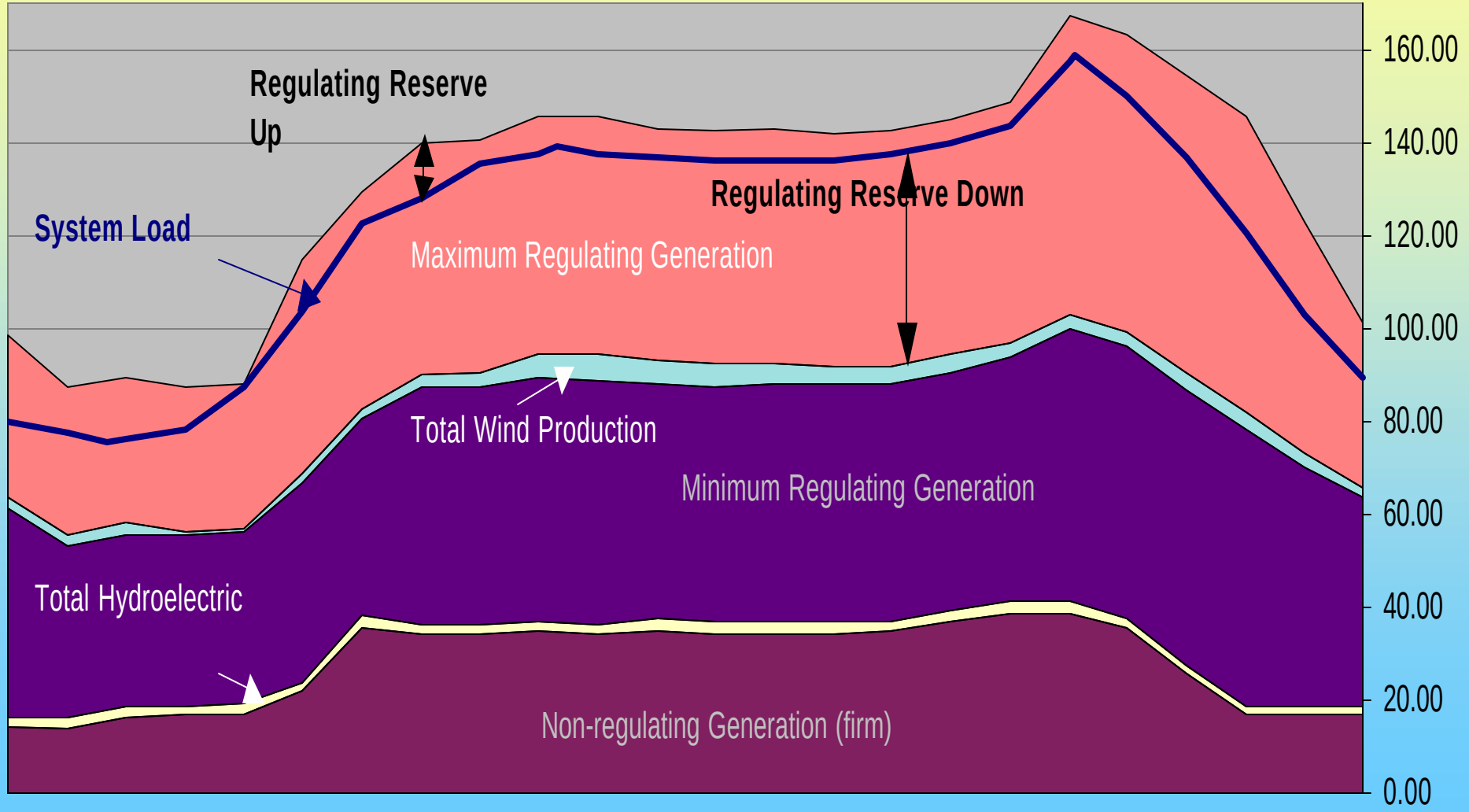


HELCO Load Curve for 3/21/02

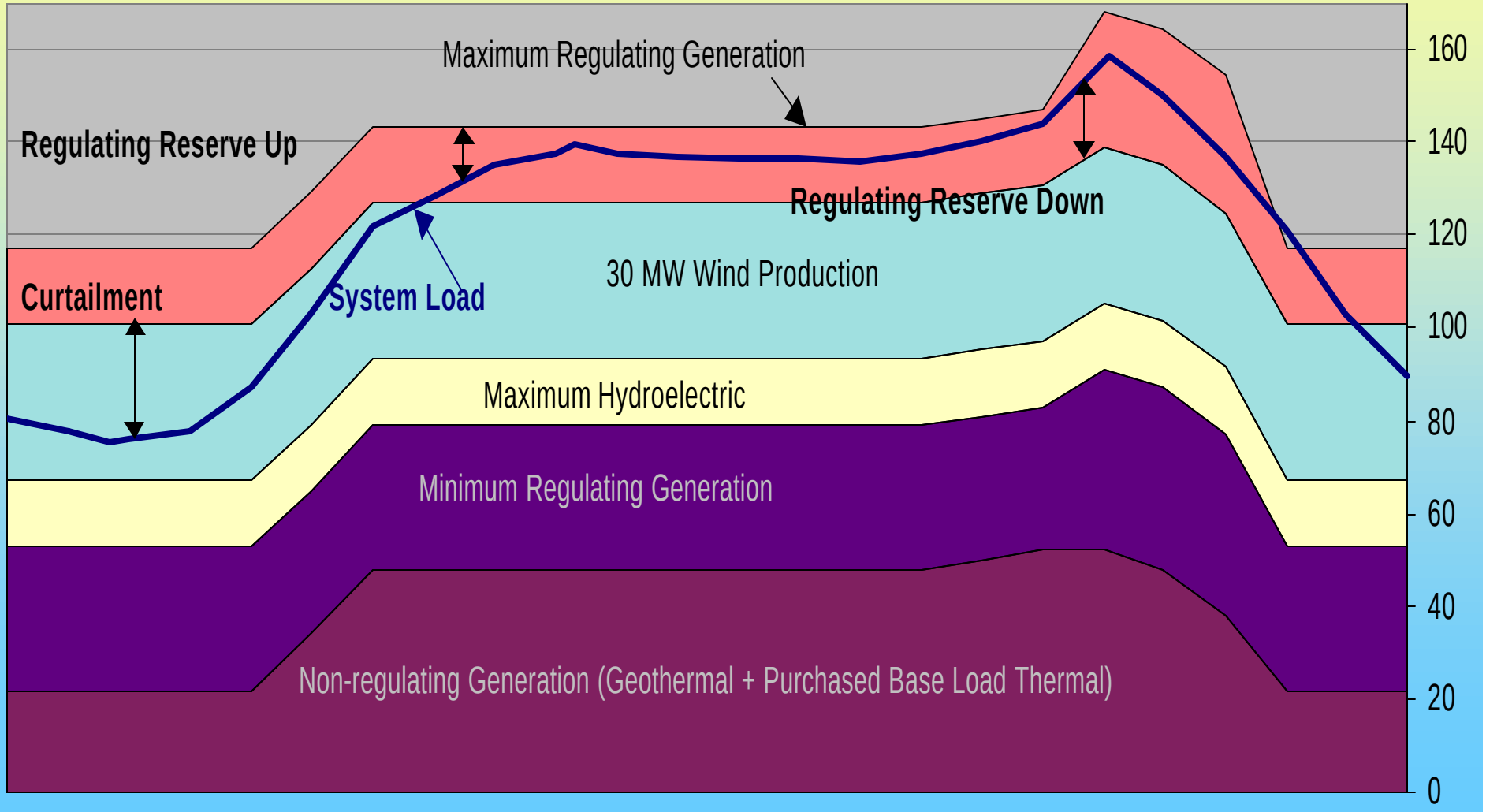
Generation Capcacity from Actual Measured Data



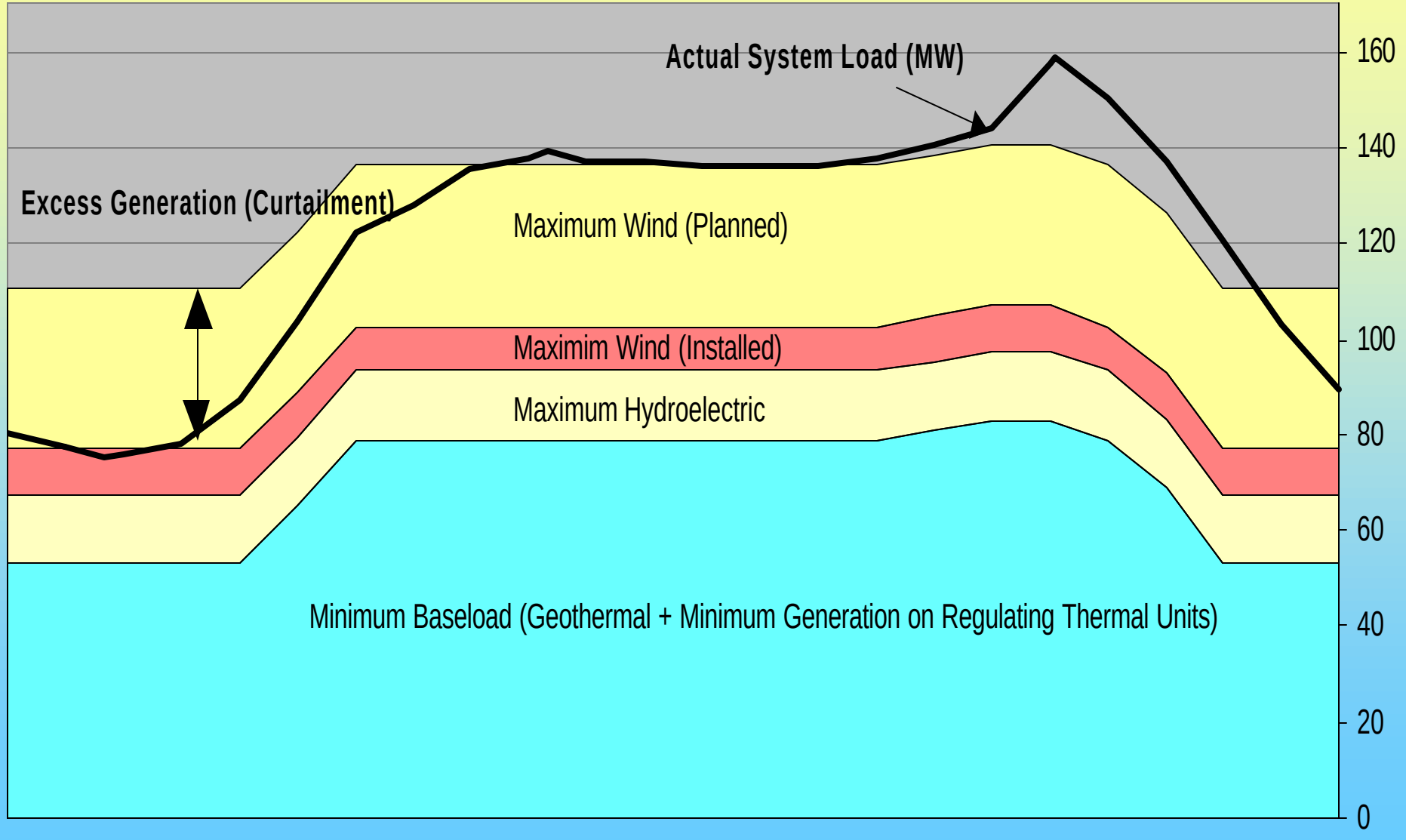
HELCO Load Curve for 3/21/02
Generation Characteristics from Actual Measured Data

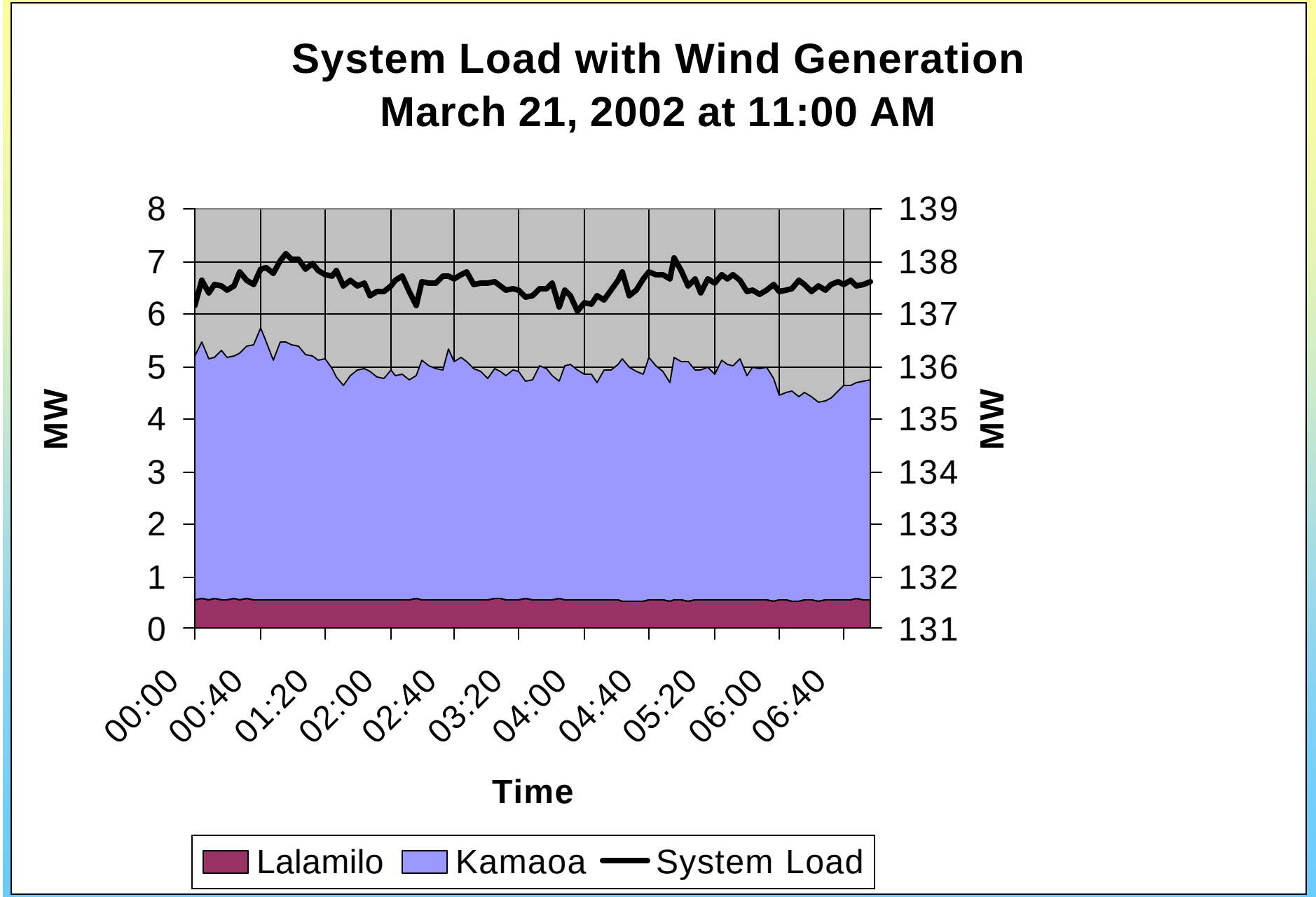


HELCO Load Curve for 3/21/02
Generation Characteristics for Future Wind Production
(Assumes Three Steam Units can Maintain Frequency)



HELCO Load Curve (Typical)
With Minimum Base-load + Maximum As-avaialable Generation




System Load with Wind Generation
March 21, 2002 at 11:00 AM
MW
MW
8
7
6
5
4
3
2
1
0
139
138
137
136
135
134
133
132
131
00:00
00:40
01:20
02:00
02:40
03:20
04:00
04:40
05:20
06:00
06:40
Time
Lalamilo
Kamaoa
System Load

Conclusions

- Electricity generation on the Big Island is very diversified with 26% from Renewables in 2001
- Experience with 1st-generation wind turbine technology dates back to 1985; comprised <5% of total generation at apex.
- Load centers and load growth in concentrated in West Hawaii and generation is concentrated in East Hawaii, hence transmission issues are critical in terms of technical infrastructure and cost.
- Wind resources are very good on the Big Island but located at weak spots in the transmission system and where electricity demand (i.e., load) is minimal.
- New wind farms totaling 43 MW in progress (>25% of peak demand)

Conclusions (cont'd)

- Load varies by factor of 3X on a daily basis; balancing of load and generation achieved primarily through automatic generation control (AGC) of thermal units.
- Wind energy is volatile on sub-second basis, which can adversely affect power quality. Need 3rd-generation wind turbine technology to help alleviate power quality problems (e.g, frequency deviation) on the grid.
- Renewable generation (wind, hydro, geothermal) can not be scheduled when needed.
  - Wind accommodated today due to amount of wind generation relative to that of regulating units.
  - Future--- To accommodate significantly more wind generation, wind farms must meet power quality standards and face curtailments at times.

Thank You